BOULDER-ELKHORN TMDL PLANNING AREA SEDIMENT MONITORING

Sampling and Analysis Plan

Prepared by:

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Approvals

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This document constitutes the Sampling and Analysis Plan (SAP) for the completion of sediment impairment determination, source assessment and loading estimates for the listed streams in the Boulder-Elkhorn TMDL Planning Area (TPA).

1.0 Introduction and Background

The Boulder-Elkhorn TPA encompasses an area of approximately 760 square miles in Jefferson County, in southwestern Montana (**Figure 1**). The TPA is bounded by the continental divide to the west, Boulder Hill to the north, the Elkhorn Mountains to the northeast, and Bull Mountain to the southwest. Elevations in the Boulder TPA range from approximately 1,304 to 2,868 meters (4,275 - 9,415 feet) above mean sea level. The lowest point is the confluence of the Boulder and Jefferson Rivers. The highest point is Crow Peak, at the northeast corner of the TPA. Much of the TPA is rugged and mountainous, with three distinct valleys: Elk Park, a long, narrow valley drained by Bison Creek; the Boulder Valley near Boulder, a high basin hemmed in by mountains; and the Boulder River valley below Elkhorn Creek, a broad river valley opening to the Jefferson River Valley. The uplands are characterized by steep-sided valleys with gently sloping ridgelines and peaks. The Boulder river itself flows a distance of approximately 70 miles, and the TPA (which includes the entire Boulder River watershed) contains 374 miles of named streams. An estimated 2,245 persons lived within the TPA. Basin and Boulder had reported populations of 255 and 1,300 in the 2000 census, respectively. The remainder of the population is sparsely distributed. Much of the TPA is unpopulated.

Mining, timber and agriculture were historically major components of the economy. Current land use within the TPA is dominated by forest and agriculture. Agriculture in the lowlands is primarily related to the cattle industry: irrigated hay and dry grazing. Mining remains a major economic activity within Jefferson County, but these active mining sites are predominantly located outside the TPA. Slightly more than one-third (37%) of the TPA is privately owned, and approximately half (51%) is administered by the US Forest Service. The remainder of the TPA is administered by the US Bureau of Land Management (8%) or Montana State Trust land (3%) Private land is generally concentrated in the valley bottoms and foothills and public land in the uplands, although patented mining claims are scattered throughout the mountains.

Under Montana law, an impaired water body is defined as a water body for which sufficient and credible data indicates non-compliance with applicable water quality standards (MCA 75-5-103). Section 303 of the Federal Clean Water Act requires states to submit a list of impaired water bodies or stream segments to the U.S. Environmental Protection Agency (EPA) every two years. Prior to 2004, this list was referred to as the "303(d) list", but is now named the "Integrated Report". The Montana Water Quality Act further directs states to develop TMDLs for all water bodies appearing on the 303(d) list as impaired or threatened by "pollutants" (MCA 75-5-703).

A total of thirteen streams in the Boulder-Elkhorn TPA will be included for sediment and habitat investigation, including Basin Creek, Bison Creek, Cataract Creek, Elkhorn Creek, High Ore Creek, Little Boulder River, Lowland Creek, McCarty Creek, Muskrat

Creek, North Fork Little Boulder River, Nursery Creek, Uncle Sam Creek, and the mainstem Boulder River. All of these streams have been listed on the 2008 303(d) list for sediment *except*, Bison Creek, Little Boulder River, Lowland Creek, and Muskrat Creek (which are listed for habitat alterations).

2.0 Objectives and Design

The objective of this sampling plan is to collect sediment and stream habitat data that will be used for the following:

- Verification of sediments impairment conditions on 303(d) listed tributaries in the Boulder-Elkhorn TMDL Planning Area
- Quantification of sediment loads associated with specific land use categories in the Boulder-Elkhorn TMDL Planning Area to assist in TMDL sediment load allocations

Study Design

In order to meet the above objectives, substrate character and stream habitat conditions will be determined by extensive sampling in streams within the Boulder-Elkhorn watershed. Longitudinal surveys that include pebble counts, grid toss, cross sections, pool data collection, riparian greenline surveys, and eroding bank information will be performed at each of the selected sample sites during the late summer/early fall of 2010.

Following procedures described in the DRAFT document *Watershed Stratification Methodology for TMDL Sediment and Habitat Investigations* (DEQ 2008), stream reaches within the Boulder-Elkhorn watershed were stratified by Ecoregion, stream order, valley gradient, and channel confinement. An additional stratification was performed through the use of aerial photography in order to identify distinct riparian conditions and to note areas of apparent local impacts.

Selection of Candidate Assessment Reaches

Candidate assessment reaches were selected in relatively low-gradient portions of the streams to facilitate the evaluation of sediment loading impacts. Other considerations in selecting candidate assessment reaches included representativeness of the candidate reach to other reaches of the same slope, order, confinement and Ecoregion, and ease of access.

Within each candidate assessment reach, survey reaches ranging from 500, 1000, or 1500 feet will be established based on bankfull width of the stream during the field assessment. Refer to the *Field Methodology for the Assessment of TMDL Sediment and Habitat Impairments* (DEQ 2010) for additional details.

There are 26 currently identified primary sediment sampling sites spatially distributed throughout the Boulder-Elkhorn TPA (**Figure 2**). Several secondary, or alternate, sampling sites have also been identified in the event that primary sites cannot be

evaluated. Sampling sites were chosen to include streams where data will assist with impairment determinations, as well as represent the range of landscape characteristics and land use/ land cover influences existing in the watershed. Sampling sites were identified by both assessment of aerial images and field surveying to capture the variability in land use and watershed characteristics potentially contributing to sediment impairment issues in streams including: stream order, valley confinement and slope, Ecoregion, and land use/land cover (e.g. known mined areas, forest, grass, riparian area, geology, and soils). The primary and secondary (alternate) sites proposed for sediment and habitat sampling in the Boulder-Elkhorn TPA are provided in **Table 1**.

Table 1. Selected Sites for Sediment and Habitat Assessment.

Stream	Primary Sites	Secondary Sites
Basin Creek*	BASI 08-02	
	BASI 15-03	BASI 15-01, 15-02
Bison Creek	BISO 04-02	
	BISO 11-01	
Boulder River*	BLDR 12-04	
	BLDR 13-02	
	BLDR 13-04	
	BLDR 13-12	BLDR 13-10
	BLDR 13-23	
	BLDR 13-33	
Cataract Creek*	CATA 14-02	
	CATA 18-01	
Elkhorn Creek*	ELKH 23-01	
	ELKH 28-01	
	ELKH 34-03	
High Ore Creek*	HIOR 14-01	HIOR 13-01, 13-02, 15-01
	HIOR 09-01	
Little Boulder River	LBLR 37-01	
	LBLR 32-01	LBLR 33-01
Lowland Creek	LOWL 08-01	
McCarty Creek*	MCCA 20-01	MCCA 18-01, 25-01
	MCCA 27-01	
Muskrat Creek	MUSK 22-02	MUSK 19-01, 18-01
North Fork Little Boulder*	NFLB 43-01	NFLB 42-01
Nursery Creek*	NURS 07-01	
Uncle Sam Gulch*	USGU 10-01	

* Sediment listed streams

At the time of this SAP, access agreements for sites proposed for sediment investigation have not been confirmed at all locations. Sites may be added, removed, or substituted with appropriate replacements if site conditions or accessibility prohibit sampling. Decision of removal or substitution of sites will be made by DEQ personnel at the time of the field investigation.

3.0 Field Sampling Methods

All monitoring and data collection will be done in accordance with the approach described in *Field Methodology for the Assessment of TMDL Sediment and Habitat Impairments* (DEQ 2010) and *MDEQ's Field Procedures Manual* (DEQ 2005a). In addition, one difference to the field methodology will be conducted for the 2010 sampling effort; riffle pebble counts will be conducted at 4 riffle cross sections, as opposed to 3, as stated in the methodology. This and any other modifications that may need to be conducted in the field will be determined by the DEQ TMDL project officer and will be discussed with all field crew members before field work begins.

4.0 Quality Assurance and Quality Control Requirements

Data quality objectives (DQOs) are the quantitative and qualitative criteria established for a sampling design in order to meet the project's objectives. Data Quality Indicators (DQIs) are quantitative criteria established for the data acquired within this design to assure it is of sufficient quality for its intended use.

DQOs

Representativeness

Representativeness refers to the extent to which measurements represent an environmental condition in time and space. This is a judgmental sampling design using the following rationale:

Spatial representation:

> Sampling sites were chosen to represent the potential of landscape characteristics and land use/ land cover influences existing in the watershed to influence the stream substrate character, and stream morphology and habitat conditions. Sampling sites were identified by both assessment of aerial images and field surveying to capture the variability in land use and watershed characteristics potentially contributing to sediment impairment issues in streams including: stream order, valley confinement and slope, Ecoregion, and land use/land cover (e.g. known mined areas, forest, grass, riparian area, geology, and soils).

Temporal representation

> This study is designed to document a stream's geometry, riparian condition, and substrate characteristics. It uses bankfull width and depth for many of its measures, which is based upon a 1.2 – 2.0 year return cycle.

Comparability

Comparability is the applicability of the project's data to the project's decision rule. The decision rules used for this project will be determined based on reference data for

sediment and habitat conditions based upon regional data, internal data (no/limited human impact), and literature values.

Completeness
Completeness is a measure of the amount of data prescribed for assessment activities and the usable data actually collected, expressed as a percentage. Completeness is determined after the evaluation of the project's DQIs.

> Example:
> There are approximately 25 sites planned with 5 individual study 'cells' per site for a total of 125 results. The overall project goal is 85% completeness. Sites lost due to inaccessibility will reduce the total number of sites in the equation above but not the completeness goal. If any listed stream has less than 50% of its planned sites sampled due to accessibility issues, the project conclusions will note this fact and account for the increased uncertainty in the TMDLs margin of safety.

DQIs

Precision
Precision refers to the degree of agreement among repeated measurements of the same characteristic. DEQ has tested the reproducibility of the measurements employed in this design and found that the precision of repeat measurements is sufficient relative the total variance from cell to cell. The greatest source of result variance comes from the heterogeneity of a study site (due to natural/human disturbance variability) rather than systematic and random error of individual measurements. Therefore, DEQ feels that precision of measurements is controlled satisfactorily through training and adherence to the sampling protocols described in *Field Methodology for the Assessment of TMDL Sediment and Habitat Impairments* (DEQ 2010)

Sensitivity
Sensitivity refers to the limit of a measurement to reliably detect a characteristic of a sample. Similar to precision, the sensitivity of measurements was tested during method development. No modification to the measurement increments or units specified in DRAFT *Longitudinal Field Methodology for the Assessment of TMDL Sediment and Habitat Impairments* (DEQ 2009) are allowed without consent from the DEQ TMDL Project Officer.

Bias
Bias is directional error from the true value. In this context, it is an extension of the representativeness concept applied to an individual sample. Bias can occur either during site selection or measurement.

The criteria for site selection in this study, as described in DRAFT *Watershed Stratification Methodology for TMDL Sediment and Habitat Investigations* (DEQ 2008) is designed to reduce bias and identify sites that are representative of the natural (physical) influences of sediment loading, transport, and deposition in contrast to sites

with non-natural (anthropogenic) influence. Because the stratification of a watershed is so key to controlling bias in the resulting data, all decisions made during the stratification process will be overseen by the DEQ TMDL Project Officer.

5.0 Data Analysis, Record Keeping, and Reporting Requirements

A review of field data will be conducted following receipt of the field data package. All data collected as part of this SAP will be evaluated against the methods cited in section 4.0. Data qualifiers may be assigned to data that does not appear to have followed these processes.

The following is a summary of the data qualifier codes that may be used:

> J - The associated numerical value is an extreme outlier to the dataset but the process appears to have been followed based on the supporting data and field notes. The use of a "J" qualifier allows the TMDL project officer to consider whether the value should be used outright, with caution, or censured from the dataset.
>
> R – The associated numerical value is an extreme outlier to the dataset and the process appears NOT to have been followed based on the supporting data and field notes. The data are unusable; resampling and/or reanalysis are necessary if completeness goal is not met due to this data being rejected.

Summary of Data Quality

A summary discussion of data quality will be prepared following review of field documentation and data. The data quality analysis will summarize the QA/QC information from the field event, audit information, corrective actions taken (if any), and the overall results of sampling activities with respect to compliance with the provisions of this SAP. The primary focus of the data quality analysis will be an estimate of the effects any deviations from approved procedures may have on the project objectives or data uses.

Data generated during this project will be stored on field forms and in electronic spreadsheets and summary reports. Written field notes and forms will be processed by WET and/or DEQ staff following QA/QC procedures to screen for data entry errors. All approved data will be input into an electronic spreadsheet format for future analysis purposes.

6.0 Schedule for Completion

Field sampling is scheduled to begin Tuesday, August 31, and will continue until finished, (with days off on weekends/holidays), likely sometime between September 10 and September 17.

7.0 Project Team and Responsibilities

DEQ's contractor, Water & Environmental Technologies (WET), will, unless otherwise requested, provide 3 personnel, and Montana DEQ will provide 2 individuals to complete the project. The field team will consist of a minimum of 5 personnel. WET will be responsible for data collection, management, and reporting under the direction of DEQ, with DEQ to provide assistance in the field. A list of personnel and their titles is provided in **Table 2**.

Table 2. Project Team Personnel.

Responsibility	Personnel
TMDL Project Manager	Jim Bond – TMDL Senior Planner, MDEQ
Quality Assurance Officer	Mindy McCarthy – QA Officer, MDEQ
Contractor Project Manager	Josh Vincent – Project Manager, WET
Field Assessment	John Babcock – Hydrogeologist, WET Josh Vincent – Principal Engineer, WET John Trudnowski - Senior Engineer, WET Jay Slocum – Biologist/GIS Specialist, WET Jim Bond – TMDL Senior Planner, MDEQ Eric Sivers – Hydrogeologist, MDEQ Christina Staten – TMDL Planner, MDEQ
Data Compilation and Analysis	John Babcock – Hydrogeologist, WET Josh Vincent – Project Manager, WET

8.0 References

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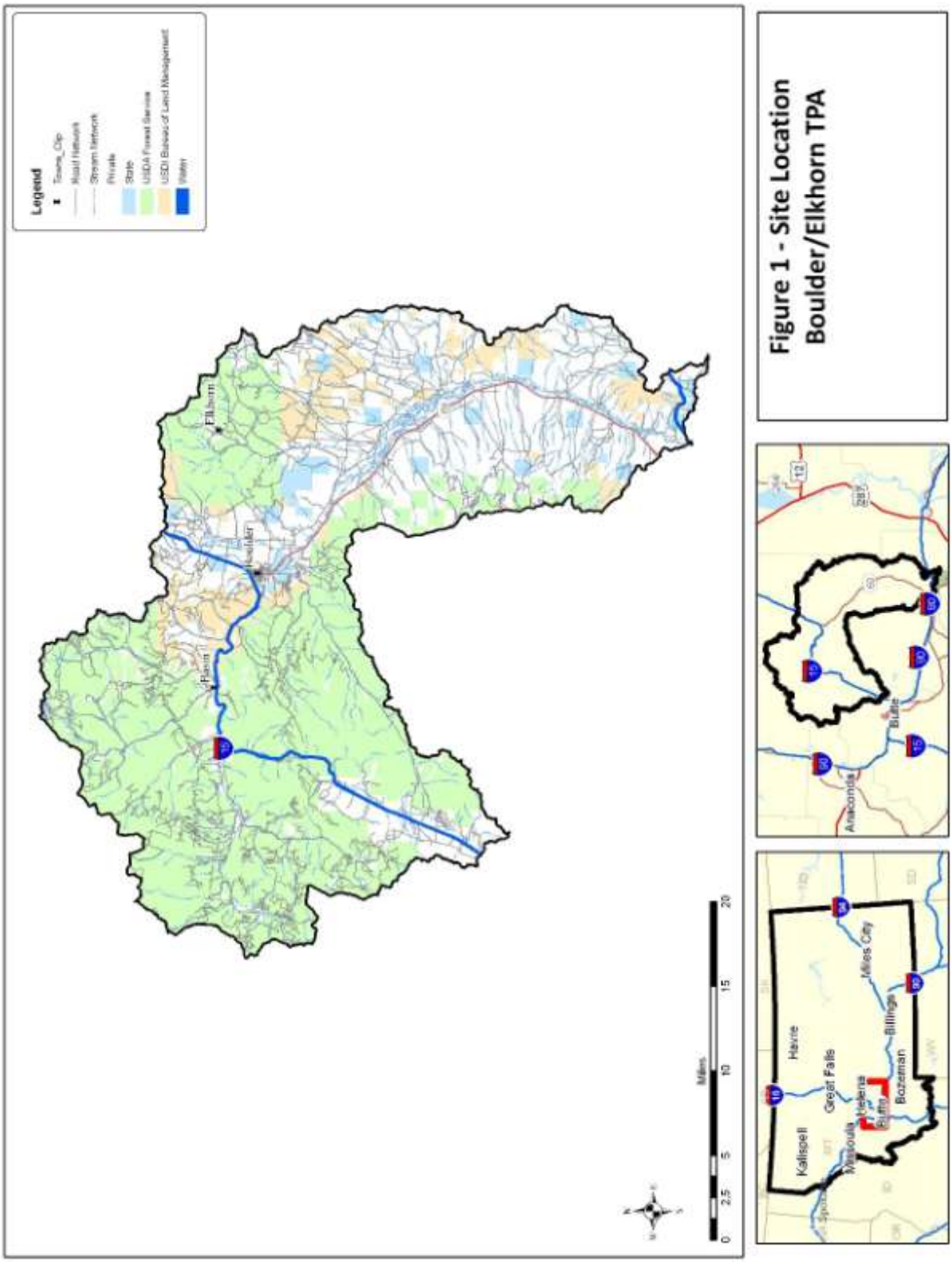

Figure 1 – Site Location Boulder/Elkhorn TPA.

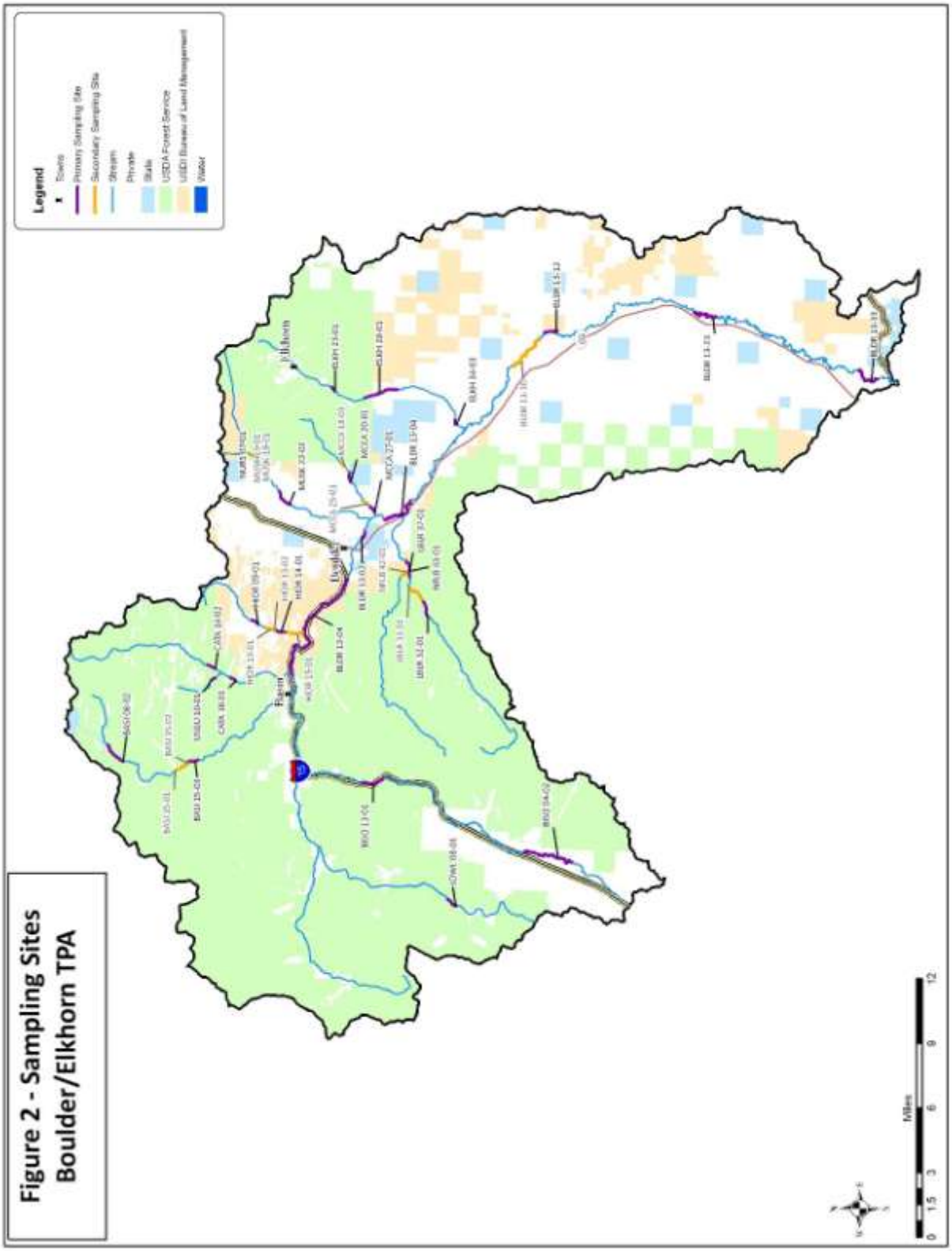

Figure 2 – Sampling Sites Boulder/Elkhorn TPA.